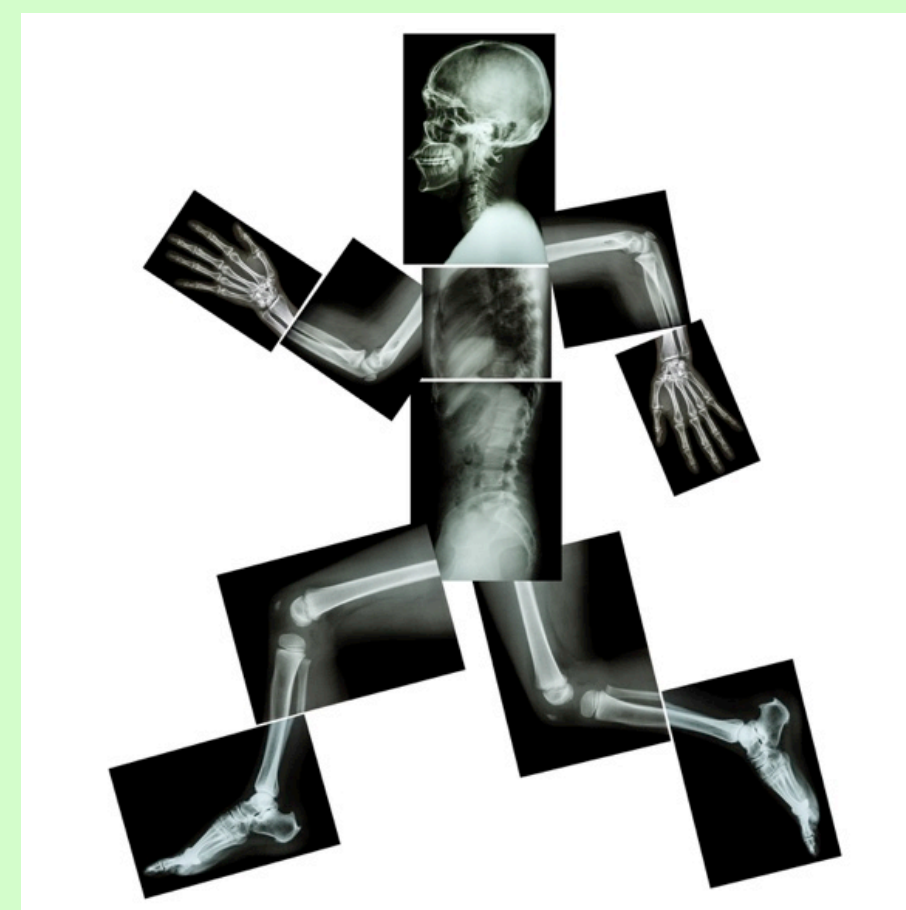


Biomechanics for Conceptual Engagement of Physics Students (BiCEPS)

◆ Background

A large proportion of students enrolled in PHYS 114, Conceptual Physics major in *Health and Human Performance* or *Exercise and Sport Science*. PHYS 114 is a pre-requisite for those students to take their Strength & Conditioning course EXSS 465 that has replaced a previous biomechanics course.



◆ Data Acquired

- All students were asked to sign a consent form or opt out of taking part in the research study via a pre-approved IRB Human Subjects Course Certification Protocol.
- General Education pre- and post-instruction assessment
- Demographic survey (gender identity, major, class level)
- Physics Self-Efficacy Questionnaire (PSEQ)

◆ Physics Self-Efficacy Questionnaire

- | | | | | |
|-----------------|----------|----------|----------|--------------|
| SD | D | N | A | SA |
| Strong Disagree | Disagree | Neutral | Agree | Strong Agree |
1. I generally manage to solve difficult physics problems if I try hard enough
 2. I know I can stick to my aims and accomplish my goals in physics
 3. I will remain calm in my physics exam because I know I will have the knowledge to solve the problems
 4. I know I can pass the physics exam if I put in enough work during the semester
 5. The motto "If other people can, I can too" applies to me when it comes to physics.

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◆ Biomechanics Activities

Student Selection of Activities

Students were asked to rank their top three choices for activities of greatest interest from a broad list of topics:

- Optics – seeing in the dark, night vision, infrared, microscopes, telescopes, radio...
- Medicine – X-rays, MRI, PET scans, gamma rays, proton beam therapy, radiation...
- Calories – burning energy, heat, engines, power plants, humans...
- Flying – airplanes, balloons, boats, rivers, curveballs...
- Sports – hang-time, vertical jump, launch angle, air pressure, sliding friction, long shots...
- Relativity – time travel, space travel, worm holes, warp speed...
- Collisions – tackles, players, cars, billiards, flopping...
- Quantum – particles as waves, transporter beams, teleportation, magic...
- Electronics – circuits, power, blowing fuses, batteries, holiday lights...
- Subatomic – nuclear fission, fusion, particles, quarks...

Top Activities Chosen

Out of seven activities (every two weeks), the four most popular selected by the students were designed specifically to highlight biomechanics applications.

1. Collisions & Safety – exploring impact force and impulse and techniques to reduce concussions
2. Torque and Angular Momentum – knee joint and quadriceps muscle force on patellar tendon and tibia
3. Electricity – examining the human body as a circuit and the shock hazard posed by dry vs. wet skin resistance
4. Heat Flow – metabolic energy required to run flights of stairs, calories burned, and temperature change

◆ Emoji Rating Sheet

Immediately after each lab, students rated their motivation for and understanding of each lab using a five emoji scale. Space was also provided encouraging a brief explanation.

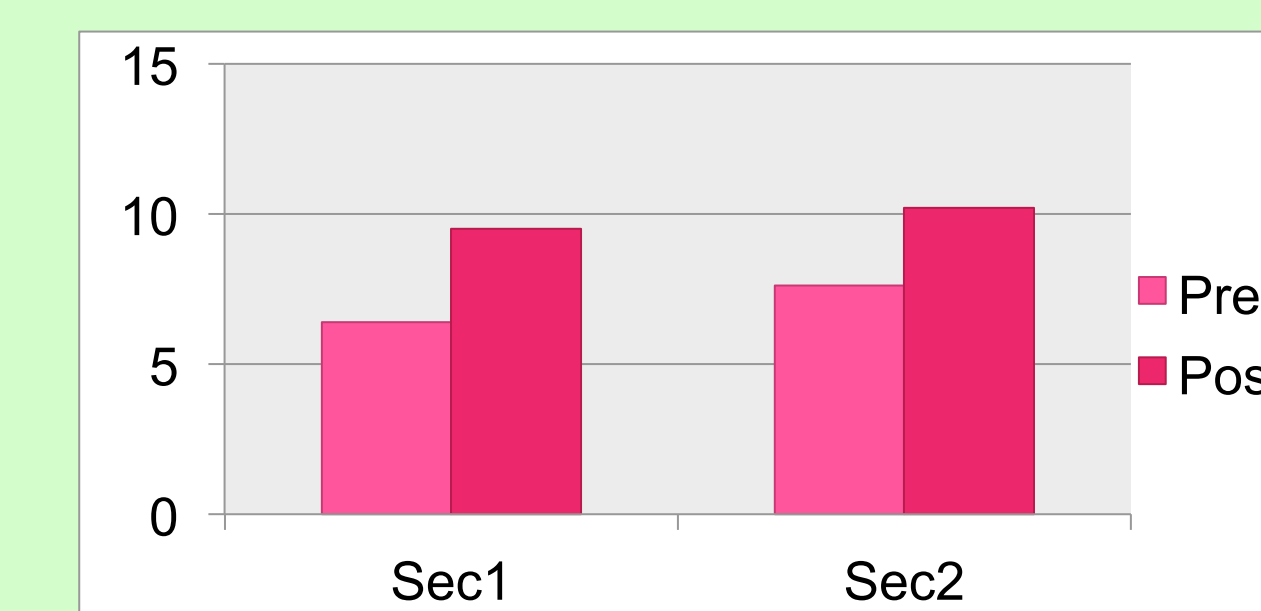


Typical written comments were often "It was fun and easy to understand" or a very similar sentiment.

◆ Results

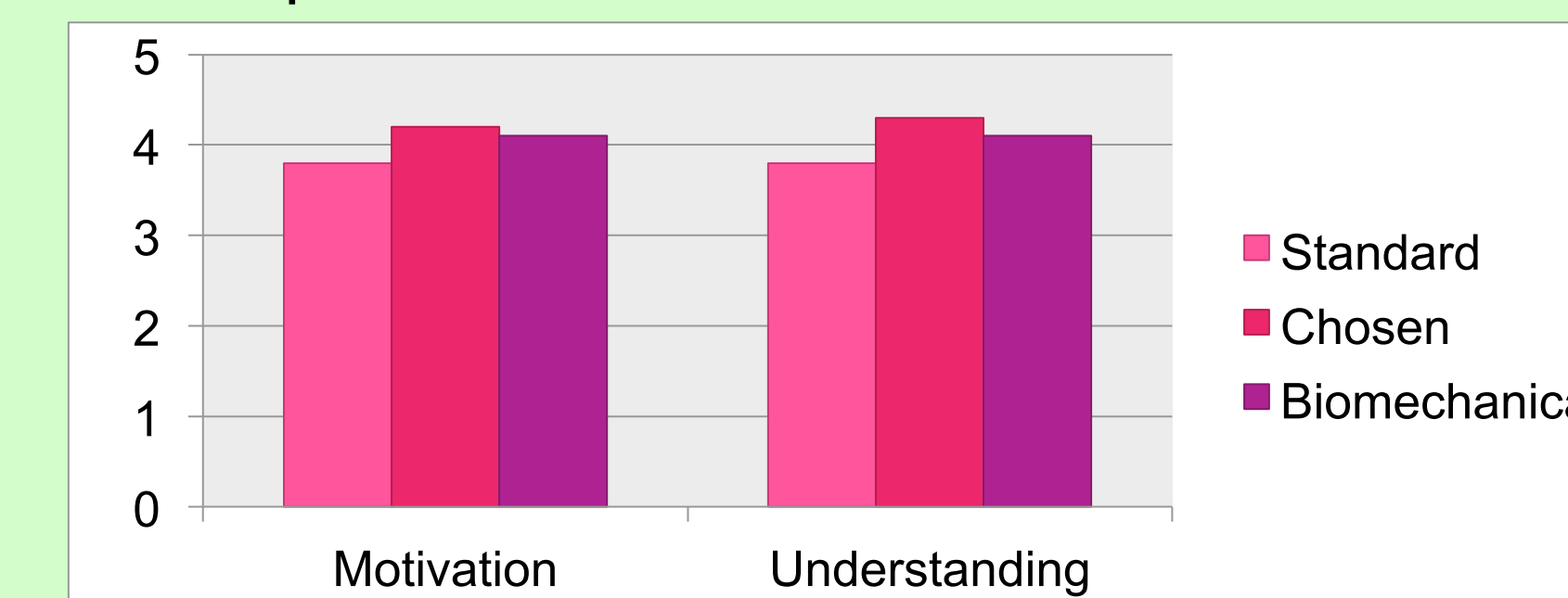
Performance

Scores improved from the pre- to the post-course assessment questions (15 total). The gain in sec1 where similar activities were done without tailoring them specifically to the biomechanics aspects was similar to (slightly higher) the gain in the biomechanics oriented sec2.



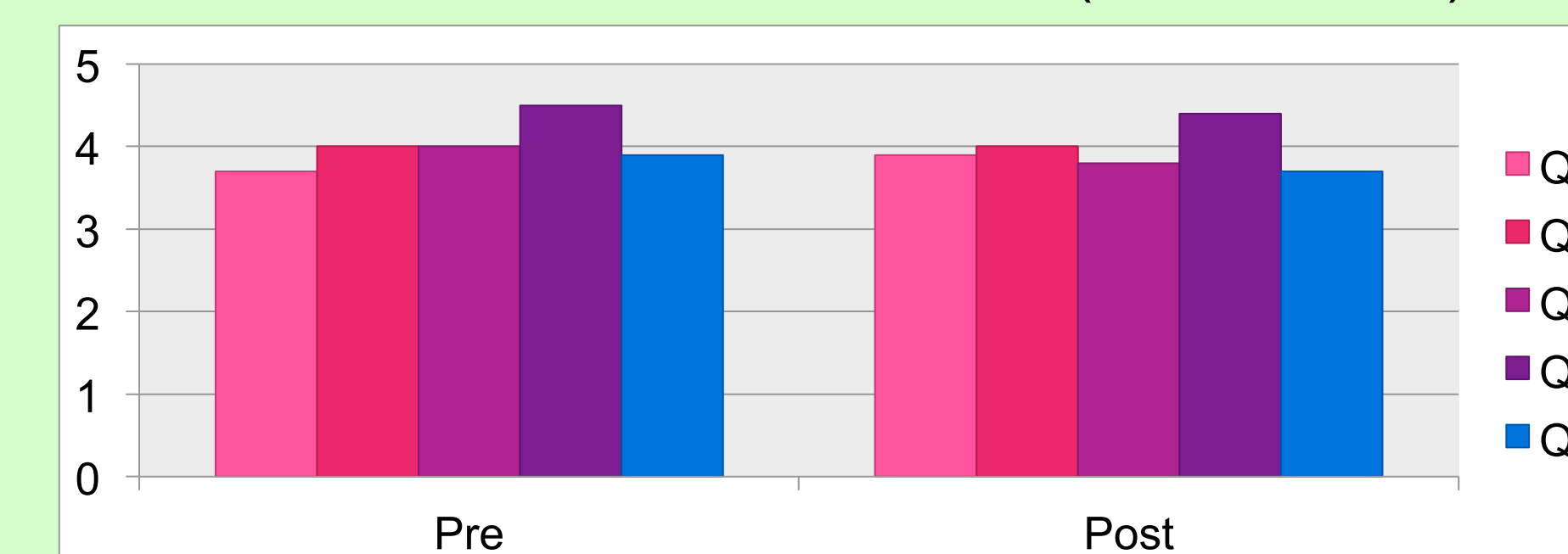
Emoji Feedback

Emoji ratings (angry=1, happy=5) were slightly higher for the four labs that were focused on biomechanics, but those ratings were also higher on those labs in the course section where the focus was not on the biomechanics aspects.



Physics Self-Efficacy

Students self-efficacy in Physics according to their responses on the PSEQ was quite high both coming into the course and exiting the course, with no clear increase in between. (SD=1, SA=5)



◆ Acknowledgements

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